

Tutorials work for chapter Alternating current

Exercise N°1

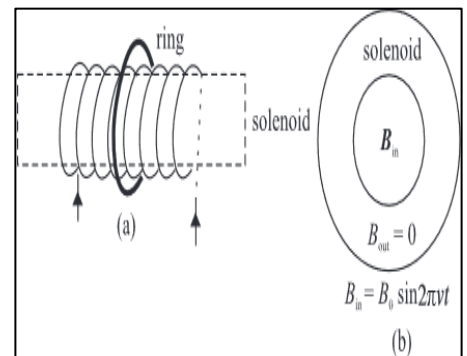
Express the following signals in the standard form, $A \sin(\omega t + \theta)$.

- a- $v_1(t) = 20 \cos \omega t$
- b- $v_2(t) = 100 \sin \omega t + 75 \cos \omega t$
- c- $v_3(t) = 10 \cos(\omega t - \frac{\pi}{2})$

Exercise N°2

1- The axis of a 75 turn circular coil of radius 35mm is parallel to a uniform magnetic field. The magnitude of the field changes at a constant rate from 25mT to 50 mT in 250 ms. Determine the magnitude of induced emf in the coil in this time interval.

2- Consider a long solenoid with a cross-sectional area 8cm² (Fig.a and b). A time dependent current in its windings creates a magnetic field $B(t) = B_0 \sin 2\pi \nu t$. Here B_0 is constant, equal to 1.2 T. and ν , the frequency of the magnetic field, is 50 Hz. If the ring resistance $R = 1.0\Omega$, calculate the emf and the current induced in a ring of radius r concentric with the axis of the solenoid.



Exercise N° 3

A magnetic field \vec{B} is directed outward perpendicular to the plane of a circular coil of radius $r=0.50m$. The field is cylindrically symmetrical with respect to the center of the coil, and its magnitude decays exponentially according to $B = 1,5 \cdot e^{(-5t)}$, where B is in teslas and t is in seconds.

- 1- Calculate the emf induced in the coil at the times $t_1=0$, $t_2=5.0 \times 10^{-2}s$, and $t_3=1.0s$.
- 2- Determine the current in the coil at these three times if its resistance is 10Ω .

Exercise N° 4:

I- Consider a sinusoidal voltage with Rms value $U_{eff}=15 V$ and period $T=1ms$.

- 1- Calculate its maximum value, frequency and angular frequency.
- 2- Express the instantaneous voltage as a function of time. This voltage is 10 V at the initial instant.
- 3- Determine the complex amplitude of this voltage.

II- Using the complex method, determine the sum of the three voltages defined by their RMS values and initial phases

$$\begin{aligned}\underline{U}_1 &= (55 V, 90^\circ) = 55 V \left| \underline{90^\circ} \right. \\ \underline{U}_2 &= (75 V, 45^\circ) = 75 V \left| \underline{45^\circ} \right. \\ \underline{U}_3 &= (100 V, 0^\circ) = 100 V \left| \underline{0^\circ} \right.\end{aligned}$$

Exercise N° 5

The instantaneous value of an alternating current is: $i(t) = 15.5A \sin(100\pi t - \pi/6)$

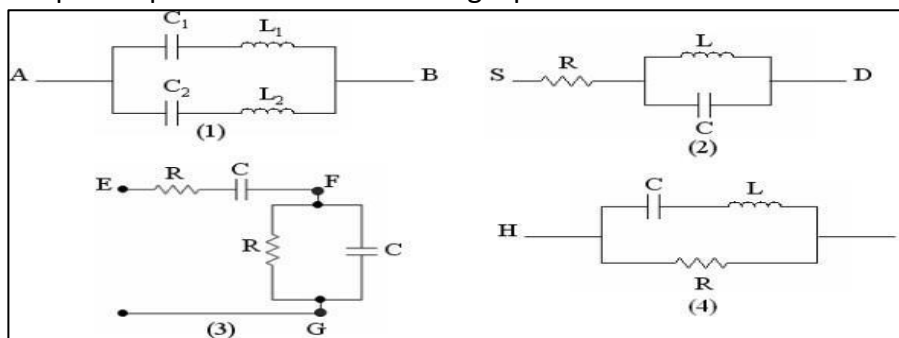
1. What is the Maximum value of the alternating current?
2. What is the RMS value of the current (effective value)?
3. What is the angular frequency? Deduce the value of the frequency and the period.
4. Calculate the value of the current at time $t = 0$, at time $t = 5$ ms and at time $t = 10$ ms.
5. This current is applied to a 20Ω resistor. Express the voltage u across this resistor.
6. Calculate the rms voltage.

Exercise N° 6

We give the impedances: $Z1 = -j1500\Omega$, $Z2 = \left[30, \frac{\pi}{2}\right]\Omega$, $Z3 = 10\Omega$, $Z4 = \left[30, \frac{\pi}{6}\right]\Omega$ and $f = 50\text{Hz}$
Identify the corresponding elementary components and calculate the values of these elements.

Exercise N°7

Determine the complex impedances of the following dipoles:

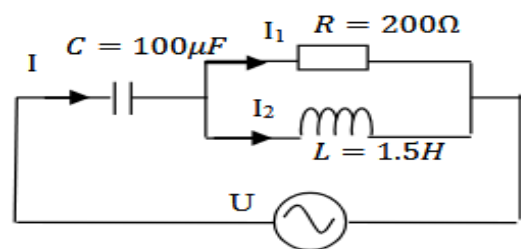


We have: A.N : $R = 1\text{ k}\Omega$, $C = 1\text{ }\mu\text{F}$ and $f = 5\text{ kHz}$

Exercise N°8

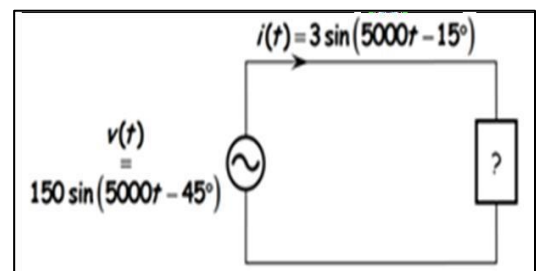
For the circuit below $U = 200\angle 0^\circ$, $f = 50\text{Hz}$

- 1) Establish the intensities of the currents in each branch and the voltages across each dipole.
- 2) Give the Fresnel representation of the currents, taking the supply voltage as the phase reference.
- 3) What is the nature of the load?

**Exercise N°9**

Let's consider the electric circuit shown in the following figure.

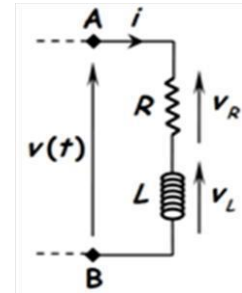
1. Express $v(t)$ and $i(t)$ in polar form.
2. Determine the impedance of the circuit.
3. Identify the elements of the circuit.



Exercise N°10

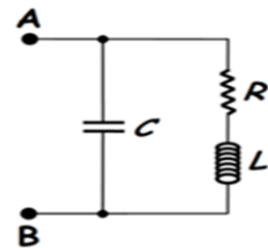
Let AB be the section of an electric circuit shown in the adjacent figure with: $R=150\ \Omega$, $L=0.5\ \text{H}$,
 $v(t) = 33.9 \sin(100\pi t)$.

1. Calculate the impedance Z_{AB} of the given section.
2. Calculate the phase shift φ imposed by this section of the circuit.
3. Calculate i , and then deduce v_L and v_R .
4. Verify that $v(t) = v_L(t) + v_R(t)$

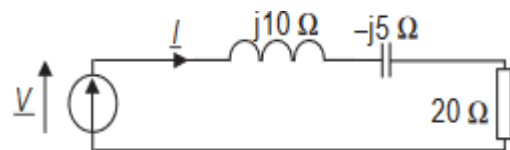
**Exercise N°11**

The adjacent dipole is powered by a sinusoidal voltage with $\omega=314\ \text{rad/s}$, $C=1\ \mu\text{F}$, $R=50\ \Omega$ and $L=0.1\ \text{H}$.

1. Calculate the magnitude and argument of the admittance Y_{AB} .
2. Deduce the magnitude and argument of the impedance Z_{AB} .
3. Determine the element to place in parallel between terminals A and B so that the impedance Z_{AB} . (Viewed between A and B) is purely real. What can be said, then, about the current and voltage of the dipole?

**Exercise N°12** Vector representation of currents and voltages

Consider the circuit shown in the following figure, where \underline{V} is the complex representation of a sinusoidal voltage of rms value $V = 100\ \text{V}$ and frequency $50\ \text{Hz}$. The components of this circuit are directly characterized by the value of their complex impedance.



- 1) Calculate the rms value I_{eff} of the current \underline{I} .
- 2) Calculate the phase of the current if we consider the voltage at the phase origin. Write the temporal expression of voltage v and current i .
- 3) Write the Loop law governing this circuit.
- 4) Represent all the complexes forming this loop law on a vector diagram in the complex plane (Fresnel diagram: phasor diagram).

Exercise N°13

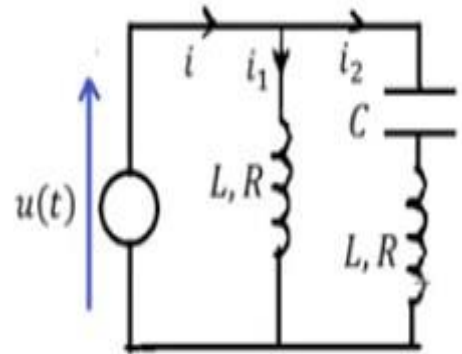
Sketch the phasors for the following voltages on the same diagram and state for each pair the leading voltage and the angle of lead.

- a- $v_A(t) = 100\sqrt{2} \sin(\omega t + 30^\circ) = 100\sqrt{2} \sin(\omega t + \pi/6)$
- b- $v_{AB}(t) = 120\sqrt{2} \cos(\omega t)$
- c- $v_C(t) = 200 \cos(\omega t + 60^\circ)$

Exercise 14

Consider the circuit shown in the figure, subjected to a sinusoidal voltage $u(t) = U \cos(\omega t)$. We ask you to determine the currents $i_1(t) = I_1 \cos(\omega t + \varphi_1)$, $i_2(t) = I_2 \cos(\omega t + \varphi_2)$ and $i(t) = I \cos(\omega t + \varphi)$.

- 1- Determine $i_1(t)$ using respectively:
 - a- The complex method
 - b- Fresnel construction.
- 2- Determine $i_2(t)$ using the complex method. Is i_2 in phase advance (leading) or lagging relative to $i_1(t)$?
- 3- What relationship must L , C and ω satisfy for $i_2(t)$ to be in phase with $u(t)$? Reduce the corresponding frequency.

**Exercise N° 15**

A single-phase workshop consists of three machines - loads 1, 2 and 3 - connected in parallel to the same 50 Hz sinusoidal voltage of rms value $U_{eff} = 230V$.

Load 1	Load 2	Load 3
$P_1 = 20Kw$	$S_2 = 45KVA$	$S_3 = 10KA$
$Q_1 = 15KVAR$	$\cos\varphi_2 = 0.6AR$	$Q_3 = -5KVAR$

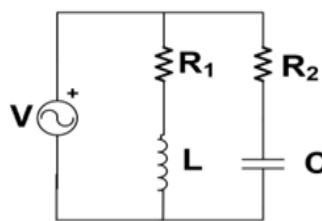
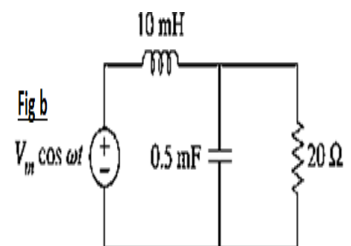
1. Calculate for each load: the current absorbed, active, reactive and apparent power and the power factor.
2. Deduce the value of the total active power P_T and the total reactive power Q_T consumed by the total load.
3. Calculate the total apparent power S_T , the overall power factor and the total absorbed current I_T .

Exercise N°16

- 1- Find out if there is a value of C to reach resonance at $f_0 = 2500/\pi Hz$

$R_1 = 8\Omega$, $R_2 = 8.34\Omega$ and $Z_L = j 8 [\Omega]$ (circuit in fig a)

- 2- Determine the resonance frequency of the circuit (see fig b) and calculate the value of current at the resonance. **Given** : $V_m = 20V$

**Fig a****Fig b**